THE MOSQUITOES OF JAPAN AND THEIR MEDICAL IMPORTANCE

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Tsai-Yu Hsiao and Richard M. Bohart

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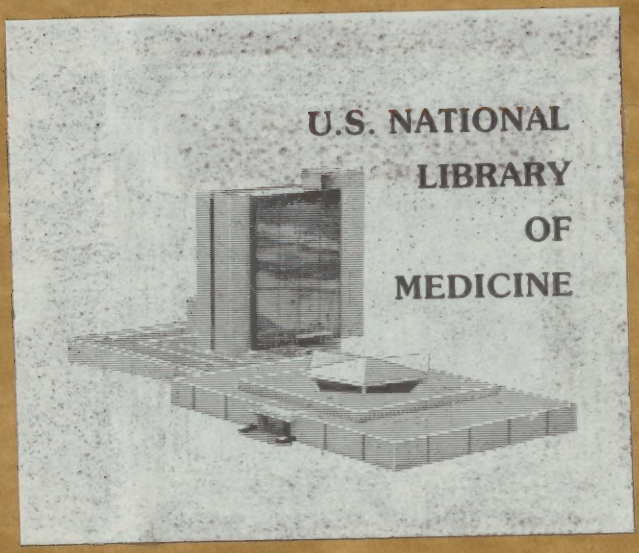

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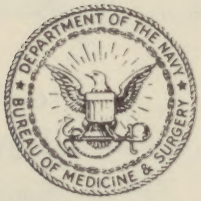

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By Tsai-Yu Hsiao[1/] and Richard M. Bohart[2/]

I. INTRODUCTION

Most of the Japanese work on mosquitoes has been relatively unavailable, either because of publication in obscure journals or because it was written in Japanese. This paper is intended to fill the need of a general summary or synopsis. For reasons of convenience the area treated has been limited to the main Japanese Islands and the Bonin Group. The mosquito fauna of this area is predominantly Palearctic with an infusion of Oriental species, especially in Kyushu. We are considering a total of 44 species and subspecies of which 6 are Anopheles, 17 are Aedes, 15 are Culex and the rest are distributed 1 each to 6 other genera. A few of the species appear to be restricted to 1 or more of the main islands but most of them occur also in Korea, the Soviet Far East or China. Of the 44 Japanese species we have studied material of 35 and Japanese specimens of 23. For the other species, for most of the distribution records and for information on disease transmission, we have had to rely on various publications. Chief among these are Edwards (1921), S. Yamada (1921, 1924, 1925, 1927, 1932), Midzuki and Mihara (1927), M. Yamada (1936), Awaya (1942), Tokunaga (1943), and Miyakawa (1945). Some of the distribution records were taken from relatively minor Japanese sources such as Takenaka (1934), Hirose (1935), Ogasawara (1939), Higashi (1939), Iwata (1940, 1941), and Iwata and Ushiya (1941). Some Japanese literature sources have not been available to us and it is probable that they contain additional information of Japanese species.

Four species, Tripteroides bambusa, Culiseta kanayamensis, Aedes nobukonis and Culex hayashii were originally described in Japanese. For the convenience of occidental workers we are including redescriptions of these based on the originals.

In treatment of synonymy we have for the most part included only those names used by Japanese authors or by others who have worked on the Japanese fauna.

We are indebted to the U. S. National Museum for use of its facilities and mosquito collection; Dr. Alan Stone of the Division of Insect Identification, U.S.D.A., has helped us on many problems which have arisen; and the keys have been checked by R. L. Ingram, CPhM, USN. We would also like to thank Dr. D. J. Borror and J. N. Belkin, recent collectors in Japan, for the use of their notes and specimens.

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II KEY TO THE MOSQUITOES OF JAPAN

ADULTS

1. Abdominal tergites without overlapping scales; palpus about as long as proboscis in both sexes; scutellum not divided into lobes (Anophelini: Anopheles) 2
   Abdominal tergites scaled; palpus shorter than proboscis in females and some males; scutellum trilobed except in Megarhinus (Culicini and Megarhinini) 7

2. Wing not spotted ..... Anopheles insulaeflorum (p. 14)
   Wing spotted 3

3. Palpus pale-banded 4
   Palpus not pale-banded 5

4. Wing with two white spots on apical half of costal margin; base of hind tibia not white banded ..... Anopheles sinensis (p. 12)
   Wing with four white spots on costal margin, the basal two much smaller; base of hind tibia with white band ..... Anopheles sineroides (p. 13)

5. Wing with only one pale spot on the costal margin; tarsi entirely dark; hind femur with a broad yellowish white band at middle ..... Anopheles lindesaii japonicus (p. 14)
   Wing with 4 or 5 pale spots on costal margin; tarsi pale banded; hind femur otherwise marked 6

6. Wing with 4 pale spots on costal margin ..... Anopheles koreicus (p. 13)
   Wing with 5 pale spots on costal margin ..... Anopheles edwardsi (p. 13)

7. Tarsi without pale band or definite pale marks 8
   Tarsi with pale bands or marks at least on some segments 24

8. Scutellum with most or all scales broad and appressed; palpus not white tipped 9
   Scutellum with all scales narrow 13

9. Scutum with a large anterior white spot which in female is divided into 2 spots .....
..... Aedes albolateralis[3/] (p. 20)
Scutum without a large anterior white area 10

10. Abdominal tergites dark; scutal integument with a dark oval spot over wing base; vein 6 ending closer to base of wing than fork of 5; male palpus very short...
..... Uranotaenia bimaculata (p. 16)
Abdominal tergites not all dark, no dark scutal spots; vein 6 ending nearer to wing tip than fork of 5 11

11. Vertex with narrow curved scales in median area; scutellum with silvery scales; thoracic integument dark brown; abdominal tergites with lateral papal spots or with complete basal bands .....
..... Aedes alboscutellatus (p. 22)
Vertex with decumbent scales broad and appressed; scutellum with at least some dark scales 12

12. Thoracic integument rather evenly dark; abdominal tergites with lateral white patches; male palpus longer than proboscis by about one-half length of apical segment ..... Armigeres subalbatus (p. 17)
Thoracic integument varied, blackish on scutum with front margin narrowly pale, mesepimeron and sternopleuron black, pronotal lobes yellow; abdominal tergites with lateral silvery spots, male palpus short as in female ..... Tripteroides bambusa (p. 15)

13. Scutum with a median longitudinal pale line 14
Scutum without a median pale line 15

14. Wing scales clumped at bases of fork cells and on crossveins, giving a spotted effect; femora and tibiae with prominent apical yellowish spots; vertex with light yellow narrow curved scaled medially; abdomen with basal pale bands; scutum with a curved lateral yellowish line and a scattering of yellowish scales anteriorly ... Culiseta kanayamensis (p. 16)
Wing scales not clumped; tibiae all dark; vertex with broad appressed scales medially; abdomen with lateral white spots; scutum with 2 short lateral yellowish lines; male palpus short as in female .....
..... Aedes nobukonis (p. 23)

15. Pleuron without patches of broad overlapping pale scales 18
Pleuron with patches of broad overlapping pale scales.... 19

3/ According to K. L. Knight, who has recently worked on this group, the Japanese representative may be an undescribed species.

16. Abdomen unbanded 17
Abdomen with basal pale bands 18

17. Eyes with a narrow border of bluish grey broad appressed scales almost to mid point; male antenna with specialized setae on segments VI to XI, those on VI consisting of 3 long, slender and pointed setae; basistyle with a row of 3 bristles along inner margin; male palpus a little longer than proboscis .... Culex rubithoracis (p. 25)
Eyes not bordered with broad appressed scales except at sides; male antenna without specialized setae; basistyle without 3 bristles in a row; male palpus two-thirds to three-quarters as long as proboscis..... ..... Culex hayashii (p. 24)

18. Pleuron with a dark horizontal integumental stripe from anterior pronotal lobe to beneath wing base, and a shorter one beginning at anterior median angle of sternopleuron; male antenna without specialized setae ..... Culex pallidothorax (p. 26)
Pleuron without dark stripes; male antenna with a small setal process on VIII and a longer one on IX.... ..... Culex infantulus (p. 25)

19. Vertex with broad appressed scales at middle; palpus of male short as in female..... Aedes esoensis (p. 23)
Vertex with narrow curved scales except at sides; palpus of male longer than proboscis 20

20. With 4 or more lower mesepimeral bristles; abdomen with apical pale bands ..... Culex vorax (p. 24)
With fewer than 4 lower mesepimeral bristles; abdomen with basal pale bands 21

21. Fore and mid femora, and all tibiae with a longitudinal stripe in front ..... Culex vagans (p. 30)
Fore and mid femora not striped in front 22

22. Scutum with a very broad median stripe of dark scales, outer one-third of scutum, prescutellar area and scutellum with greyish scales..... Aedes sticticus (p. 18)
Scutum without a differentiated median stripe of scales 23

23. Scutal scales ochreous tinged, second division of male mesosome very broad and plate-like .... Culex quinquefasciatus (p. 29)
Scutal scales generally reddish brown; second division of male mesosome somewhat more narrow .... Culex pipiens pallens (p. 29)

24. Scutum with metallic emerald green scales; proboscis thick on basal half, narrowed and decurved on apical half; abdominal tergites with lateral hair tufts on VI to VIII ..... Megarhinus towadensis (p. 15)
Scutum without emerald green scales 25

25. Proboscis with a sharply defined pale band at or slightly beyond the middle 26
Proboscis without a well defined median band 32

26. Wing with numerous pale scales 27
Wing scales dark 29

27. Wing speckled with yellowish scales but not spotted; abdominal tergites with apical yellowish bands and scattered yellowish scales ..... Culex bitaeniorhynchus (p. 26)
Wing with whitish spots; abdominal bands basal 28

28. First pale costal spot extending only onto subcosta ..... Culex mimeticus (p. 27)
First pale costal spot extending over vein 4 ..... Culex orientalis (p. 28)

29. Anterior surface of mid femur dark scaled 30
Anterior surface of mid femur speckled with pale scales; scutum pale on anterior two-thirds, partly or mostly dark behind this 31

30. Vertex with upright forked scales all dark; scutal scales minute and coppery brown ..... Culex tritaeniorhynchus (p. 28)
Vertex with upright forked scales dark at sides and white toward middle; scutal scales somewhat shaggy, mixed coppery brown and brownish yellow ..... Culex vishnui (p. 28)

31. Abdominal tergites with apical pale bands ..... Culex sinensis (p. 26)
Abdominal tergites with basal pale bands ..... Culex whitmorei (p. 27)

32. Wing scales pale and dark 33
Wing scales dark (except sometimes for a dot at extreme base of costa) 34

33. Scutal scales light brown and greenish, latter forming a sublateral stripe from front margins to level of wing base (less distinct in male); last hind tarsal all pale; abdominal tergites with basal bands and a median longitudinal pale stripe; wing veins 1, 3 and 5 with a preponderance of dark scales, other veins with a preponderance of white ones ..... Aedes dorsalis (p. 18)

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Scutal scales brown and cream colored; last hind tarsal with basal pale band; abdominal tergites with lateral white and yellow patches, and sometimes with apical yellow bands; wing fairly evenly speckled with broad asymmetrical yellowish and dark brown scales ..... Mansonia uniformis (p. 17)

34. Palpus in female entirely dark 35
Palpus in female marked with white 38

35. Scutum with a large patch of white scales in front, a small patch over wing base; hind tarsus with white marks on base and apex of I and base of II .... Aedes watasei (p. 20)
Scutum otherwise marked, hind tarsus with only basal white marks 36

36. Scutum without distinct pale linear markings, hind tarsus with basal white marks on all segments; male palpus with long segment followed by a moderate segment and a tiny apical one .... Aedes imprimens (p. 22)
Scutum with yellowish linear markings, hind tarsal V entirely dark; male palpus with long segment followed by 2 moderate segments 37

37. Hind tarsus with basal white marks on I to III .... Aedes japonicus (p. 18)
Hind tarsus with basal white marks on I to IV, usually a few pale scales at base of V..... ..... Aedes koreicus (p. 19)

38. Last hind tarsal all white 39
Last hind tarsal not all white 42

39. Scutum with a silvery median stripe and some short lines 40
Scutum without a single median silvery stripe 41

40. Scutum with a spot of broad white scales over wing base, posterior sublateral lines white; male ninth tergite with a median projection on posterior margin ..... Aedes albopictus (p. 20)
Scutum with some yellowish curved scales over wing base, posterior sublateral lines yellowish; male ninth tergite with a serrated posterior margin .... Aedes flavopictus (p. 21)

41. Scutum with a white pattern consisting essentially of a white line and a bowed lateral line; scutellar scales all broad, a few black ones on mid lobe; clypeus with a pair of white spots; tarsi with basal white bands only ..... Aedes aegypti (p. 20)

Scutum with golden scales arranged in a double median line forking posteriorly, a submedian anterior line, a bowed lateral line and a patch over wing base; scutellar scales whitish yellow and narrow except for a few broad ones on mid lobe; clypeus unspotted; hind tarsus with broad basal white bands on I-IV, narrow apical ones on I-III .... Aedes hatorii (p. 19)

42. Tarsal bands covering joints; scutum with a linear pattern of whitish scales, sometimes indefinite, particularly in males; vertex with black and white upright scales ..... Aedes togoi (p. 19)
Tarsal bands basal, not covering joints; all hind tarsal segments with basal pale bands 43

43. Scutum with a median yellowish white stripe and lateral bowed lines ..... Aedes galloisi (p. 21)
Scutum sometimes variegated but without definite lines... ..... Aedes vexans nipponii (p 22)

FOURTH INSTAR LARVAE[4/]

1. Without a siphon (Anophelini: Anopheles) 2
With a siphon (Culicini and Megarhinini) 7

2. Outer clypeal hairs simple 3
Outer clypeal hairs branched 4

3. Palmate hair on abdominal segment I well developed .... Anopheles insulaeflorum (p. 14)
Palmate hair on abdominal segment I not developed, hairlike ..... Anopheles lindesaii japonicus (p. 14)

4. Outer clypeal hair thickly branched into a fan-shaped tuft; pecten teeth without lateral denticles .... Anopheles sinensis (p. 12)
Outer clypeal hair with a few branches (less than 20); pecten teeth, at least the short ones, with conspicuous lateral denticles 5

5. Outer clypeal hair splitting into 11 to 15 branches; long pecten teeth darker than the short ones .... Anopheles sineroides (p. 13)

4/ Larvae of Megarhinus towadensis, Culiseta kanayamensis, Aedes imprimens, Ae. flavopictus, Ae. esoensis, Ae. galloisi, Aedes nobukonis, Ae. watasei, Ae. hatorii, Culex rubithoracis and C. orientalis have not been described.

Outer clypeal hair splitting into 4 to 6 branches; long and short pecten teeth same color 6

6. Posterior clypeal hair simple; prothoracic hair 1 branching near base ..... Anopheles koreicus (p. 13)
Posterior clypeal hair three branches; prothoracic hair 1 branching near apex ... Anopheles edwardsi (p. 13)

7. Siphon without a pecten; with a single pair of hair tufts (except on valves) 8
Siphon with a pecten 10

8. Siphon valves black and saw-toothed; antenna divided into 3 nearly equal lengths by antennal tuft and subapical bristles, shaft darkened at base and at level of tuft ..... Mansonia uniformis (p. 17)
Siphon valves small, not black; antenna cylindrical, not divided into 3 portions 9

9. Thorax with sclerotized plates bearing thick spinulose bristles; siphon tuft basally situated; gills short .... Megarhinus (p. 15)
Thorax without sclerotized plates bearing thick bristles; siphon tuft small and posterolateral; gills very large and long ..... Armigeres subalbatus (p. 17)

10. Siphon with a single pair of subventral tufts 11
Siphon with several to many pairs of sipon tufts (sometimes very small in long-siphoned species) 22

11. Siphon with tuft near base..... Culiseta (p. 16)
Siphon tuft near or beyond middle 12

12. Comb in a rather regular row 13
Comb in an irregular double row or in a patch 16

13. Comb of about 8 apically fringed teeth attached to a large sclerotized saddle which extends across eighth segment dorsally; pecten teeth fringed on both sides; antennal hair situated at apical one-third of shaft; head hairs all slender .... Uranotaenia bimaculata (p. 16)
Comb not on a sclerotized plate 14

14. Head hairs B and C and antennal tuft of more than 3 branches; pecten teeth all dark; gills very long .... Aedes albolateralis (p. 20)
Head hairs B and C and antennal tuft usually single, occasionally double 15

15. Meso- and metathoracic hairs with a large basal spine; comb teeth with well developed lateral denticles;

lateral hair of anal ring usually of 2 short equal branches ..... Aedes aegypti (p. 20)

Meso- and metathoracic hairs with a small basal spine; comb teeth with a basal fringe; lateral hair of anal ring usually of 2 unequal branches ..... Aedes albopictus (p. 20)

16. Head hairs B and C short, with 4 or more branches and situated more or less in a line across front of head; first pentad hair (just dorsal to comb) and lateral hair of anal segment usually single; anal ring incomplete 17

Head hairs B and usually C with not more than 3 branches 19

17. Gills globular; siphon tuft situated at about apical one-fifth and extending far beyond end of siphon ..... Aedes togoi (p. 19)

Gills not globular, nearly equal, about as long as anal ring; siphon tuft situated near middle and not extending beyond end of siphon 18

18. One or more distal pecten teeth very long and large, pecten teeth at middle of row with about 4 denticles on basal one-third to two-fifths ..... Aedes japonicus (p. 18)

Pecten teeth gradually increasing in length toward apex of siphon, those at middle of row with about 4 small denticles scattered along basal three-fifths ..... Aedes koreicus (p. 19)

19. One or more distal pecten teeth more widely spaced 20

Pecten teeth rather evenly spaced; antenna strongly spiculate 21 5/

20. Comb teeth sharply pointed, arranged in an irregular double row; siphon tuft longer than last pecten tooth ... Aedes vexans nipponii (p. 22)

Comb teeth rounded and fringed apically; siphon tuft not longer than last pecten tooth ..... Aedes alboscutellatus (p. 22)

21. Gills globular; head hair B single, C double ..... Aedes dorsalis (p. 18)

Gills not globular, twice as long as anal ring; head hairs B and C single ..... Aedes sticticus (p. 18)

22. Comb of fewer than 12 teeth, usually spine-like and arranged in a single row 23

5/ The larva of Aedes watasei has not been described. According to related species it should key out of couplet 21 but have the antenna smooth.

Comb in a patch of more than 12 teeth 27

23. Body thickly covered with stellate hairs; siphon with several well developed subdorsal hair tufts, a row of long double ventral tufts and a subventral tuft of about 5 branches near base of siphon; anal ring with a comb-like arrangement of spines; only 1 pair of multiple anal brushes; metathorax with a stout spine of 3 progressively shorter branches .... Tripteroides bambusa (p. 15)
Body without stellate hairs 24

24. Antennal tuft at or before middle of shaft; pecten composed of a few inconspicuous teeth at base of tube 25
Antennal tuft well beyond middle of shaft; pecten well developed 26

25. Subapical antennal bristles inserted near apex, dorsoapical siphon bristle about half as long as diameter of tube at point of insertion of bristle .... Culex bitaeniorhynchus (p. 26)
Subapical antennal bristles inserted nearly midway between apex and tuft; dorsoapical siphon bristle about as long as diameter of tube at point of insertion ..... Culex sinensis (p. 26)

26. Subventral siphon tufts shorter than basal diameter of tube; apical 2 or 3 pecten teeth strong; dorsoapical siphon bristle about half as long as apical diameter of tube ..... Culex vishnui (p. 28)
Subventral siphon tufts much longer than basal diameter of tube; dorsoapical siphon bristle about as long as apical diameter of tube .... Culex whitmorei (p. 27)

27. Pecten and siphon tufts extending along nearly entire length of tube; head hairs A, B and C long and single; mentum with about 9 teeth; antennal tuft consisting of a single short hair; anal segment nearly triangular in side view and about as long as siphon; inner and outer caudal hairs of anal segment single; gills small ..... Culex vorax (p. 24)
Pecten restricted to basal half of tube; head hairs A, B and C not all single; mentum with more than 9 teeth; antennal tuft not single 28

28. Antennal tuft at or before middle of shaft; siphon markedly tapering toward apex and with 4 or rarely 5 subventral pairs of tufts; pecten of 5 to 9 teeth .... Culex pallidothorax (p. 26)
Antennal tuft well beyond middle of shaft 29

29. Siphon about 10 times its basal diameter, usually with a dark ring at base and a broad dark median band; siphon tufts very small, usually arranged in 4 pairs .. .. Culex infantulus (p. 25)
Siphon not more than 7 times its basal diameter 30

30. Siphon with more than 4 pairs of subventral tufts 31
Siphon with not more than 4 pairs of subventral tufts 33

31. Comb teeth with an apical spine; siphon with about 10 ventral tufts usually in a slightly irregular line .... Culex mimeticus (p. 27)
Comb teeth evenly fringed at apex, siphon tufts more or less in pairs 32

32. Head hairs B and C short, not reaching front of head .... Culex hayashii (p. 24)
Head hairs B and C, or at least B extending beyond front of head ..... Culex tritaeniorhynchus (p. 28)

33. Siphon about 3.5 to 4.5 times its basal diameter; 8 to 12 pecten teeth ..... Culex quinquefasciatus (p. 29)
Siphon about 5 times its basal diameter; 12 to 18 pecten teeth ..... Culex vagans (p. 30)
Culex pipiens pallens (p. 29)

III. NOTES ON TAXONOMY, DISTRIBUTION, BIONOMICS AND RELATION TO DISEASES

ANOPHELES (ANOPHELES) SINENSIS Wiedemann.

Anopheles sinensis Wiedemann, 1828. Auss. Zweifl. Ins. 1: 547(type loc.: Canton, China).
Anopheles hyrcanus of Edwards (in part), 1921. Ann.Mag. Nat. Hist. 7: 629.
Anopheles funestus of Kinoshita, 1901. Tokyo Igakkai Zassi 16: 53.
Anopheles yesoensis Tsuzuki, 1901. Gunigakkai Zassi, No. 123 (Suppl.) (type loc.: Hokkaido).
Anopheles jesoensis Tsuzuki, 1902. Saikingaku Zassi, No. 75: 93, 95.
Anopheles pseudopictus of Kinoshita, 1903. Tokyo Igakkai Zassi 17:754.
Myzorhynchus sinensis of authors.
Anopheles (Anopheles) hyrcanus var. sinensis of Christophers, 1924. Ind. Med. Res. Mem. No. 3: 28, 86.

DISTRIBUTION. India, Burma, Malaya, Siam, Indochina, China, Formosa, Korea, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Shikoku, Honshu, Hokkaido. We have seen specimens from Nagasaki, Okayama, Wakayama, Sendai, Tokyo, Odawara (Kanagawa), and Uenohara (Honshu).

This is the most common and widespread anopheline mosquito in Japan. The larvae breed in many types of ground water such as ponds, marshes, ditches, rice fields, and slowly flowing streams. The females bite during the night and attack both man and animals. However, there is evidence to indicate that in some areas the species is distinctly zoophilic (Iwata and Ushiya, 1941). Houses are readily entered and biting takes place in darkness or dim light. Breeding is continuous from spring to autumn, with 5 or 6 generations a year.

This species is the primary vector of malaria in Japan and it has been proved capable of transmitting both P. vivax and P. malariae. It also acts as an intermediate host of filariae (W. bancrofti) although it is not as important in this respect as some of the culicines (S. Yamada, 1921).

The taxonomic status of this species has been uncertain. Edwards (1921) treated it as a synonym of An. hyrcanus Pallas on the grounds that the latter "is a variable species in many respects and shows a strong tendency to the production of local races". Christophers (1924) treated it as a variety of hyrcanus and separated it from the typical

form in the adult as having the third palpal band poorly developed, and in the larva as having the palmate hairs larger and the antennal hair longer. Because of the fact that the identity of typical hyrcanus is in doubt, we prefer to treat sinensis as an independent species.

ANOPHELES (ANOPHELES) SINEROIDES Yamada.

Anopheles sineroides Yamada, 1924. Sci. Rpt. Gov't. Inst. Inf. Dis. 3: 233 (type loc.: Bibai, Honshu).
Anopheles koreicus var. sineroides of Stackelberg, 1937. Faun. URSS Dipt. 3(4): 55.

DISTRIBUTION. China, Korea, Japan.

DISTRIBUTION IN JAPAN. Honshu, Hokkaido. We have seen specimens from Sendai and Uenohara (Honshu).

This is an uncommon species in Japan. The larvae breed in pools, marshes, and slowly flowing water. Adults have been collected in houses and have been observed to bite man (S. Yamada, 1924) but they are not known to carry malaria. Wuchereria bancrofti does not fully develop in this mosquito, according to S. Yamada (1924).

ANOPHELES (ANOPHELES) KOREICUS Yamada and Watanabe.

Anopheles koreicus Yamada and Watanabe, 1918. Jikken Igaku Zassi 2: 206 (type loc.: Heisho, Korea).
Anopheles (Anopheles) punctibasis Edwards, 1921. Bul. Ent. Res. 12(3): 274 (type loc.: Nagasaki, Japan).

DISTRIBUTION. China, Korea, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Honshu. We have seen specimens from Nagasaki, Odawara (Kanagawa), Uenohara (Honshu), and Yumoto (Kanagawa).

The larvae breed in cool spring pools, marshes, and slowly flowing water. They are sometimes associated with Culex hayashii. The adults bite at night, and have been collected indoors. Their relation to disease transmission is unknown.

This species is very closely related to An. edwardsi which is considered by some workers merely to be a seasonal variation (see remarks under edwardsi).

ANOPHELES (ANOPHELES) EDWARDSI Yamada.

Anopheles edwardsi Yamada, 1924. Sci. Rept. Gov't. Inst. Inf. Dis. 3: 238 (type loc.: Inokashira near Tokyo).

DISTRIBUTION. Korea, Japan.

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DISTRIBUTION IN JAPAN. Honshu. We have seen specimens from Nagasaki, Uenohara (Honshu), Shibotsu (Honshu), Yumoto (Kanagawa), and Odawara (Kanagawa).

The larvae of this species breed preferably in cool water and the adults appear in the early spring. They bite man readily after dark but their relation to disease transmission is unknown.

There is some evidence to indicate that edwardsi and koreicus are varieties of one species, with edwardsi the coldwater form. They were treated as seasonal varieties by Nakayama in 1942, according to Miyao and Sasa (1944). The costal markings of the wing (fig. 3, 4) are strikingly different in typical examples. However, we have examined a series of 57 specimens from Honshu (J. N. Belkin) of which the majority (35) were edwardsi, 15 were koreicus and 7 were intermediate in wing pattern. Several specimens had one wing simulating edwardsi and the other koreicus.

ANOPHELES (ANOPHELES) LINDESAII JAPONICUS Yamada.

Anopheles japonicus Yamada, 1918. Eiseigaku Densenbyogaku Zassi 13: 689 (type loc.: Kanayama, Hokkaido, and Mt.Myogi).
Anopheles lindesaii (part) of Edwards, 1921. Bull. Ent. Res. 12: 273.
Anopheles lindesaii var. japonicus of Christophers, 1931. Rec. Malaria Surv. India 2(2): 321.

DISTRIBUTION. China, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Shikoku, Honshu, Hokkaido.

This is an uncommon but widely distributed species in Japan. The larvae breed in cool spring water or shaded pools in the mountains (above 300 m.). Adults will bite man in the evening, but have not been observed to enter habitations. There is no evidence of disease transmission.

Yamada (1924) considered this mosquito as identical with the Formosan An. pleccau Koidzumi, but Morishita (1936) treated the latter as synonymous with typical lindesaii.

ANOPHELES (ANOPHELES) INSULAEFLORUM Swellengrebel and Swellengrebel de Graaf

Anopheles aitkenii var. insulae florum Swellengrebel and Swellengrebel de Graaf, 1919. Meded. Burg. Ned. Ind. D., 9. Addend., p. 2 (following p. 118), (type loc.: Noesa Kambangan (Isle of Flowers), S. Java).

DISTRIBUTION. India, Ceylon, Malay Peninsula, Java, New Guinea, Lesser Sunda, Moluccas, Natuna Islands, Philippines, Formosa.

DISTRIBUTION IN JAPAN. Honshu.

This is a species with unspotted wings. The larvae breed in shaded streams. Ogata-wara (1930) reported two species from Honshu, but this record appears to be somewhat doubtful. Its relation to disease is unknown.

MEGARHINUS TOWADENSIS Matsumura.

Megarhina towadensis Matsumura, 1916. Thousand Ins. Japan, Add. 2: 445 (type loc.: Towada, Honshu).

DISTRIBUTION. Japan (Honshu).

This is the largest known Japanese mosquito, the adult attaining a body length of 13 mm. It has been collected from various localities on Honshu. It does not bite man.

According to Stackelberg (1937), towadensis is synonymous with christophersi Portschinsky.

TRIPTEROIDES (TRIPTEROIDES) BAMBUSA (Yamada).

Rachionotomyia bambusa Yamada, 1917. Dobuts. Zasshi, 29: 61 (type loc.: Tokyo, Japan).

DISTRIBUTION. China, Japan, Formosa.

DISTRIBUTION IN JAPAN. Kyushu, Honshu, Hokkaido. We have seen specimens from Nagasaki.

The following redescription is based on a translation of the original:

Female.--Vertex with a dense covering of broad appressed scales, anterior two-thirds ultramarine in color as seen anteriorly and greyish brown from posterior view, posterior one-third dark and with a row of dark forked scales, lateral areas of vertex silvery white; proboscis dark, seven times as long as palpus which is also dark. Scutum mostly postnotum and mesopleuron with dark brown integument; pronotum, anterior margin of scutum, scutellum and remainder of pleuron yellowish brown; scutum with narrow dark scales, scutellar scales broad and dark with a bluish luster, anterior pronotal lobe with broad dark scales, posterior pronotal lobe with narrow dark scales, mesopleuron with two large spots of white scales; femora with two round white spots on apical one-half anteriorly, fore and mid femora with a white line along basal one-half, hind femur with a similar line joining a pale area on ventral side, tibiae and tarsi dark. Abdominal tergites with pearly white lateral spots on II-VII, these sometimes forming bands; venter yellowish.

Male.--Palpus about one-sixth as long as proboscis. Dististyle narrowed toward middle.

Larva.--Antenna smooth, with a single hair at apical one-fifth; head hairs short and single except for 4 or 5 branched hair A; mentum triangular with a large central tooth and 9 lateral teeth. Thorax with a large hooklike process on either side of metanotum, the process with 1 long and 2 or 3 shorter branches; thorax and abdomen with many stellate hairs. Comb with a regular row of dense spines, longest at middle; siphon with an inconspicuous pecten of scattered teeth, tube about 3.5 times as long as broad, with scattered tufts and a ventral median row; anal segment with a dorsal plate which bears small posterior spinules; gills equal in length and about 3 times as long as anal plate.

Egg.--Length 0.5 mm., diameter 0.2 mm. Spindle-shaped and dull greyish, surface reticulate. Eggs are laid singly on water surface.

Larvae occur in cut bamboo, tree holes, and occasionally in artificial containers. Adults have been observed to bite man during the day, but the species is not a suitable host for W. bancrofti (S. Yamada, 1927).

This species is very similar to the Malayan T. vicina Edwards, but bambusa has narrow curved rather than broad appressed proepimeral scales, the larger claw of the fore leg of the male notched rather than toothed and the metathoracic larval spine of 3 or 4 branches rather than double.

URANOTAENIA BIMACULATA Leicester.

Uranotaenia bimaculata Leicester, 1908. Cul. Malaya, p. 226 (type loc.: Selangor, Malay Peninsula).

DISTRIBUTION. Malay Peninsula, India, China, Japan, Ryukyu.

DISTRIBUTION IN JAPAN. Kyushu, Honshu, Ryukyu. We have seen specimens from Nagasaki and Tokyo.

The larvae are found in tree holes, cut bamboo, and occasionally in rock holes. The adults do not feed on man but have been reported to attack toads.

CULISETA KANAYAMENSIS (Yamada).

Theobaldia kanayamensis Yamada, 1932. Nippon Konchu Zukan, p. 218 (type loc.: Kanayama, Hokkaido).

DISTRIBUTION. Japan (Hokkaido).

This is a large dark species marked with light yellow. Yamada described and figured it in 1932 without designating it as a new species However, we have been unable to find an earlier description. The adult is reported to bite at night, but it is apparently a rare species not concerned in disease transmission. Its breeding habits are unknown.

The following is a brief redescription based on a translation of that

of Yamada (1932):

Female.--Length 7.5 mm., wing 6 mm.; large species, dark with light yellow markings. Vertex with light yellow curved narrow scales at middle and similarly colored broad appressed scales laterally; proboscis dark; palpus about one-sixth proboscis, with dark brown and light yellow scales. Scutum with dark bluish scales and light yellowish ones forming a median line, a curved lateral line and a scattering of scales anteriorly. Abdominal tergites dark with narrow transverse basal light yellow bands, those of V to VII forming a lateral triangular spot. Wing scales clumped at crossveins and forks so as to form dark brown spots. Femora and tibiae with conspicuous light yellow scale spots, fore and mid femora with an anterior longitudinal line; tarsi all dark.

MANSONIA (MANSONIOIDES) UNIFORMIS (Theobald).

Panoplites uniformis Theobald, 1901. Mon. Cul. 2: 180 (type loc.: Travancore, S. India and Taiping, Malay Peninsula).
Taeniorhynchus uniformis of authors.

DISTRIBUTION. From Africa through Oriental Region to Japan and Australia.

DISTRIBUTION IN JAPAN. Kyushu, Honshu.

Larvae breed in swamps and pools thickly overgrown with vegetation. Both larvae and pupae obtain oxygen by puncturing aquatic plants under water. The adults are strongly anthropophilic and attack both by day and by night. Yamada (1932) reported that this species was a suitable host of filarial larvae.

ARMIGERES (ARMIGERES) SUBALBATUS (Coquillett).

Culex subalbatus Coquillett, 1898. Proc. U. S. Nat. Mus. 21: 302 (type loc.: Japan).
Culex obturbans of authors.
Armigeres obturbans of authors.
Desvoidya obturbans of authors.

DISTRIBUTION. India, Burma, Malay Peninsula, Sumatra, Thailand, China, Indochina, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Shikoku, Honshu, Hokkaido. We have seen specimens from Nagasaki and Tokyo.

This is a large dark species with white markings and unbanded tarsi. The larvae are scavengers and usually breed in very foul water. They are often found in artificial containers and cut bamboo. Adults are persistent biters in the evening and in the shade during the day. Yamada (1927) reported that W. bancrofti larvae did not develop to the infective stage in this species.

AEDES (OCHLEROTATUS) DORSALIS (Meigen)

Culex dorsalis Meigen, 1830. Syst. Berschr. Zweifl. Ins. 6: 242 (type loc.: Berlin).
Grabhamia broquetii Theobald, 1913. Entom. 46: 179 (type loc.: Tetchili, North China and Tamsui, Formosa).

DISTRIBUTION. Holaretic, Saghalien, Japan.

DISTRIBUTION IN JAPAN. Honshu, Hokkaido.

The larvae breed in ground pools and marshes. The females bite man during the day but W. bancrofti larvae do not develop to maturity, according to S. Yamada (1927).

AEDES (OCHLEROTATUS) STICTICUS (Meigen).

Culex sticticus Meigen, 1838. Syst. Beschr. 7: 1 (type loc.: Europe).

DISTRIBUTION. Northern and Central Europe, Siberia, Saghalien, Japan, North America.

DISTRIBUTION IN JAPAN. Common in northern Hokkaido.

The larvae are found for the most part in either open or shaded water, generally of a temporary character (Marshall, 1938). Females attack man during the day, especially in the early morning. W. bancrofti larvae do not develop in this species (S. Yamada, 1927).

AEDES (FINLAYA) JAPONICUS (Theobald).

Culex japonicus Theobald, 1901. Mon. Cul. 1: 385 (type loc.: Tokyo, Japan).

DISTRIBUTION. China, Formosa, Japan, Siberia.

DISTRIBUTION IN JAPAN. Kyushu, Shikoku, Honshu. We have seen specimens from Nagasaki and Tokyo.

The larvae have been collected in rock holes in the vicinity of hill country streams, and in the clear water of artificial containers, such as concrete tanks. Females bite man outdoors during the day. According to S. Yamada (1927) it is not a suitable intermediate host of W. bancrofti. Chagin and Kondrat'yev (1943) reported this species as a vector of Japanese encephalitis in the Soviet Far East.

This species is very closely related to Ae. koreicus, differing principally in details of leg markings and in the larvae. The male genitalia which are very similar in the two species, have been figured for japonicus by Ho (1931).

AEDES (FINLAYA) KOREICUS Edwards.

Aedes (Ochlerotatus) koreicus Edwards, 1917. Bul. Ent. Res. 7: 212 (type loc.: Korea).
Aedes japonicus var. koreicus of Ho, 1931. Bull. Fan. Mem. Inst. Biol. 2(8): 127.

DISTRIBUTION. Korea, China, Japan.

DISTRIBUTION IN JAPAN. Hokkaido.

The larvae are commonly found in household containers such as flower pots and barrels, as well as in ground pools. The eggs winter over and hatch when the ice melts (Kobayashi, 1933). Females bite during the day but W. bancrofti larvae do not mature in this species (S. Yamada, 1927).

AEDES (FINLAYA) TOGOI (Theobald).

Culicelsa togoi Theobald, 1907. Mon. Cul. 4: 379 (type loc.: Osaka, Japan).

DISTRIBUTION. China, Korea, Siberia, Japan.

DISTRIBUTION IN JAPAN. Common in Kyushu, Shikoku, and Honshu, and rare in Hokkaido. We have seen specimens from Nagasaki, Tokyo, and Sendai.

This is a seacoast species. The larvae breed primarily in brackish rock pools just above high tide but are also found in fresh or nearly fresh water in artificial containers near the coast. The adults are reported to invade habitations to bite during the day, and to enter lighted rooms at night.

S. Yamada (1927) found that this species was readily infected with W. bancrofti larvae, a majority of which attained full development. Experimental infection with Japanese "B" encephalitis was obtained in this mosquito by Mitamura et al. (1939). It has also been reported as a vector in the Soviet Far East (Chagin and Kondrat'yev, 1943).

AEDES (FINLAYA) HATORII Yamada.

Aedes hatorii Yamada, 1921. Annot. Zool. Jap. 10(6): 70 (type loc: Taihoku, Formosa).
Aedes hatorii Yamada, 1932. Nippon Konchu Zukan, p. 223.

DISTRIBUTION. Formosa and Japan (Honshu: Chuzenji, Nikko).

The larval habitat is unknown. The adults have been reported to bite during the day. It is presumably a rare species.

AEDES (FINLAYA) ALBOLATERALIS (Theobald).

Stegomyia albolateralis Theobald, 1908. Rec. Ind. Mus. 2: 289 (type loc.: Sylhet, Assam).
Aedes niveus of Edwards (in part), 1921. Bull. Ent. Res. 12: 318.

DISTRIBUTION. India, Formosa, Korea, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Shikoku, Honshu, Hokkaido.

Larvae breed in tree holes and cut bamboo. The adults bite man during the day. Filarial larvae (W. bancrofti) undergo partial development in this species, according to Yamada (1927).

Because of the complex nature of the albolateralis-niveus group, it is possible that the Japanese representative is an undescribed species.

AEDES WATASEI Yamada.

Aedes watasei Yamada, 1921. Annot. Zool. Jap. 10(6): 64 (type loc.: Omura, Kyushu, Japan).

DISTRIBUTION. Japan (Kyushu).

This is a medium-sized species with white markings. The larvae have not been described. Adults have been collected in July attempting to bite man outdoors during the day. Its relation to disease is unknown.

AEDES (STEGOMYIA) AEGYPTI (Linn.).

Culex aegypti Linnaeus, 1762. Hasselquist's Reise nach Palestina, p. 470 (type loc.: Egypt).
Culex argenteus Poiret, 1787. Journ. Phys. 30: 245 (type loc.: Barbary).
Stegomyia fasciata of authors.

DISTRIBUTION. Widespread in tropics and subtropics. It does not occur in the main islands of Japan but has been collected from Bonin (Chichijima) and Ryukyu.

Larvae of this domestic species are found in all types of artificial containers near dwellings. The females bite both by day and by night. It is an important vector of dengue fever in the Ryukyus (Miyao, 1930). It is also a good vector of yellow fever in other parts of the world, but there is no evidence that it transmits filariasis or Japanese "B" encephalitis.

AEDES (STEGOMYIA) ALBOPICTUS (Skuse).

Culex albopictus Skuse, 1894. Ind. Mus. Notes, 3:20 (type loc.: Calcutta).
Stegomyia scutellaris of Matsumura, 1931. 6,000 Ill. Ins. Japan. p. 401.

DISTRIBUTION. Throughout the Oriental Region.

DISTRIBUTION IN JAPAN. Common species in Kyushu, Shikoku, and Honshu. We have seen specimens from Nagasaki and Tokyo.

This is a semidomestic species breeding in many types of small fresh-water collections around habitations, or in tree holes, cut bamboo, etc., in cemeteries and other places frequented by human beings. The adults are vigorous daytime biters. The species is a well-known vector of dengue and, in the apparent absence of Ae. aegypti from the Japanese main islands, it was presumably the vector in the 1942 epidemic on Kyushu. Miyao (1931) considered it a dengue vector on Okinawa. S. Yamada (1927) reported that W. bancrofti larvae only partially develop in this species.

AEDES (STEGOMYIA) FLAVOPICTUS Yamada.

Aedes flavopictus Yamada, 1921. Annot. Zool. Jap. 10(6): 52 (type loc.: Tokyo).

DISTRIBUTION. Korea, Japan.

DISTRIBUTION IN JAPAN. Rare in Honshu; common in Hokkaido.

The adults of this species are very similar to albopictus, differing only in the yellow-tinted sublateral and lateral markings of the scutum and in the male genitalia, according to the original description. The adults are active blood suckers and are said to largely replace albopictus in Hokkaido. The larvae have not been described but those of the closely related Ae. downsi R. Bohart and Ingram from Okinawa are found in tree holes, cut bamboo, rock holes and leaf axils. The species from the mountains of India figured and described as flavopictus by Barraud (1934) appears to be misidentified. Barraud's figures of the male genitalia are at variance with those of Yamada. Nothing is known of its role in transmission of disease.

AEDES (STEGOMYIA) GALLOISI Yamada.

Aedes galloisi Yamada, 1921. Annot. Zool. Japonenses, 10(6): 47 (type loc.: Sapporo, Japan).

DISTRIBUTION. Japan. Common in Hokkaido, also in Honshu and Saghalien.

This is a dark species with white and yellowish white markings. Its scutal pattern is similar to that of aegypti but the latter has a double median line and all white fifth hind tarsal segment. The larva has not been described. The adults are most common in August and have been observed to bite man under experimental conditions. W. bancrofti does not fully develop in this species, according to Yamada (1921).

AEDES (AEDIMORPHUS) ALBOSCUTELLATUS (Theobald).

Lepidotomyia alboscutellatus Theobald, 1905. Ann. Mus. Nat. Hung. 3: 80 (type loc.: Papua, New Guinea).
Aedes omurensis Yamada, 1921. Annot. Zool. Japonenses 10(6): 73 (type loc.: Omura, Kyushu, Japan).

DISTRIBUTION. India, Malaya Peninsula, Siam, Netherlands Indies, Philippine Islands and Japan.

DISTRIBUTION IN JAPAN. Kyushu (Omura).

The larvae are found in ground pools and the adults are reported to bite vigorously during the day. Its relation to disease is unknown.

AEDES (AEDIMORPHUS) VEXANS NIPPONII (Theobald).

Culicada nipponii Theobald, 1907. Mon. Cul. 4: 337 (type loc.: Karnizana, Japan).
Aedes vexans of authors.
Aedes (Ochlerotatus) vexans var. nipponii of Edwards, 1917. Bul. Ent. Res. 7: 219.

DISTRIBUTION. Korea, Amur, Saghalien, Japan.

DISTRIBUTION IN JAPAN. Honshu, Hokkaido. We have seen specimens from Tokyo and Sendai.

The larvae breed in rather temporary rain pools. The adults bite both by day and by night, but, according to S. Yamada (1927), the species is not a suitable intermediate host of W. bancrofti.

AEDES (BANKSINELLA) IMPRIMENS (Walker).

Culex imprimens Walker, 1861. Proc. Linn. Soc. London, 5: 144 (type loc.: Amboyna).
Aedes imprimens (Walker): Yamada, 1927. Sci. Rept. Gov't. Inst. Inf. Dis. 6: 571.

DISTRIBUTION. Eastern region of Himalayas, Amboina, Borneo, Japan.

DISTRIBUTION IN JAPAN. Kyushu and Hokkaido.

The habitat of this species has not been recorded in Japan. In other areas larvae have been collected from leafy ground pools. It bites man readily in deep shade. S. Yamada (1927) experimentally fed specimens on filarial patients and reported it an unsuitable host of the parasite (W. bancrofti).

The species is here placed in the subgenus Banksinella on the basis of the minute terminal palpal segment of the male and the large subter-

minal one. The male genitalia with a forked clasper and without apical spine are similar to those of Aedimorphus, however. The larvae, also, are rather typical Aedimorphus.

AEDES (AEDES) ESOENSIS Yamada.

Aedes esoensis Yamada, 1921. Annot. Zool. Japonenses, 10(6): 77 (type loc.: Kanayama, Hokkaido)

DISTRIBUTION. Siberia (Ussuri border) Saghalien, Japan.

DISTRIBUTION IN JAPAN. Common in Hokkaido; rare in Honshu.

The habitat of Ae. esoensis has not been described in Japan. In the Soviet Far East, Russian workers (Chagin and Kondrat' yev, 1943) reported that the breeding places of this species are small, warm, shallow, natural and artificial basins, microbasins of hilly marshes, pools, ditches, and holes with abundant aquatic vegetation. In calm weather the adults are very active and bite man during the day. Though spontaneous infection with Japanese "B" encephalitis has been recorded in this mosquito, Chagin and Kondrat'yev (1943) considered that its epidemiological significance as a vector of the disease is doubtful. W. bancrofti does not develop in this species (Yamada, 1921).

AEDES ESOENSIS var. FLAVUS Yamada, Nomen nudum.

Aedes esoensis var. flavus Yamada, 1927. Sci. Rept. Gov't. Inst. Inf. Dis. 6: 575.

DISTRIBUTION. Japan: Honshu, Hokkaido.

S. Yamada (1927) informally suggested this name for a mosquito which he was using in experiments on transmission of filariasis. He stated that "this mosquito is very closely allied to Aedes esoensis Yamada, but differs slightly in the coloration of its whole body and in the male genitalia". It is probably a distinct species but in the absence of specific characters Yamada's note cannot be said to constitute a valid description. The larvae of W. bancrofti do not develop fully within this mosquito, according to Yamada (1927).

AEDES (AEDIMORPHUS (?)) NOBUKONIS Yamada.

Aedes nobukonis Yamada, 1932. Nippon konchu Zukan, p. 228 (type loc.: Omura, Kyushu).

DISTRIBUTION. Japan: Kyushu (Omura).

This species was described and figured by Yamada in 1932 without designation as a new species. We have been unable to find an earlier description, however. The adult was reported to bite during the day.

The following redescription is based on a translation of that of Yamada (1932): Length of female 4.1 mm.; wing 3 mm.; small dark brown species. Vertex with broad appressed scales, four radial lines of yellowish white scales and three large dark scale spots at middle; proboscis dark; palpus dark and short, one-fifth of proboscis in female, one-sixth in male. Scutum with bluish brown scales, a lateral margin of light yellowish ones, a median longitudinal line and a shorter sublateral line also yellowish. Abdominal tergites with a row of pale laterobasal spots, venter with broad basal bands on II to VI. Femora white ventrally and at apex, apical spot on fore femur indistinct; tibiae and tarsi all dark.

CULEX (LUTZIA) VORAX Edwards

Culex (Lutzia) vorax Edwards, 1921. Bull. Ent. Res. 12: 327 (type loc.: Tokyo, Japan).
Culex tigripes of authors.
Lutzia fuscana vorax of authors.
Culex concolor of authors.

DISTRIBUTION. India, Burma, China, Japan, Korea, Malay Peninsula, Formosa.

DISTRIBUTION IN JAPAN. From Kyushu to Hokkaido. We have seen specimens from Nagasaki and Tokyo.

This is a large brownish yellow species with unbanded tarsi. The larvae are found in artificial containers or ground pools, where they prey upon other mosquito larvae. They are also cannibalistic. Commonly associated species are C. pipiens pallens and C. quinquefasciatus. Adults rarely attack man but have been induced to feed in the laboratory. Hu (1939, 1941) obtained infective larvae of both W. bancrofti and W. malayi in specimens of vorax. In view of its feeding habits it is probably of no medical importance, however.

CULEX (NEOCULEX) HAYASHII Yamada.

Culex hayashii Yamada, 1917. Dobuts. Zasshi, Tokyo, 29: 67 (type loc.: Tokyo, Japan).

DISTRIBUTION. China, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Honshu, Hokkaido. We have seen specimens from Nagasaki, Tokyo, and Uenohara (Honshu).

The following is a redescription based on the Japanese original:

Female.--Vertex with narrow curved yellowish white scales mixed with upright forked yellowish to brownish ones, a row of broad white scales along eye margins and a lateral spot of similar scales; palpus dark, about one-sixth as long as proboscis. Scutal scales brownish on a reddish brown background; pleuron dark brown with a few whitish yellow scales; legs dark except toward bases of femora. Ab-

dominal tergites dark scaled, venter yellowish.

Male.--Inner lateral process of basistyle with three rods, five needlelike leaves and four setae; dististyle broadest at base, tapering at apex.

Larva.--Antenna curved, spiculate, with a large hair tuft at apical one-third of shaft, constricted beyond this point; head hairs B and C small, triple and double respectively. Comb in a triangular patch of many fringed teeth; siphon straight and slender, tapering slightly at apex, 5.5 times its basal diameter, 11-15 comb teeth on basal one-third of siphon, teeth very long and slender with lateral denticles, six pairs of long hair tufts beyond the comb teeth; lateral hair of anal segment small and multiple, gills unequal, pointed, longer pair longer than anal ring.

Egg.--Length 0.75 mm., width 0.19 mm. Subcylindrical, pointed apically, slightly curved, micropylar end rounded, dark brown, laid in a rhomboidal raft of up to 164 eggs.

The larvae of this small dark species breed in seepage pools, rock pools and stream pools. The females are reported to feed on toads.

CULEX (LOPHOCERATOMYIA) INFANTULUS Edwards.

Culex (Lophoceratomyia) infantulus Edwards, 1922. Ind. Jour. Med. Res. 10: 287 (type loc.: Hongkong).

DISTRIBUTION. China, Okinawa, Japan, Philippines, Thailand.

DISTRIBUTION IN JAPAN. Kyushu, Ryukyu. We have seen specimens from Nagasaki.

Larvae of this small dark species are found in seepage pools, stream pools and rock pools. Adults do not attack man.

The male genitalia are distinctive in having the mesosome processes covered with numerous platelike thickenings.

CULEX (LOPHOCERATOMYIA) RUBITHORACIS Leicester.

Culex (Lophoceratomyia) rubithoracis Leicester, 1908. Cul. Malaya, p. 119 (type loc.: Kuala Lumpur, Malay Peninsula).

DISTRIBUTION. India, Burma, Thailand, China, Malaya, Formosa, Borneo, Japan.

DISTRIBUTION IN JAPAN. Kyushu. Western Honshu.

Larvae of this species have not been described. The females do not attack man but have been observed to feed on toads.

CULEX (CULICIOMYIA) PALLIDOTHORAX Theobald.

Culex pallidothorax Theobald, 1905. Jour. Econ. Biol. 1: 32 (type loc.: India).

DISTRIBUTION. Southern China, India, Burma, Siam, Indochina, Malaya, Celebes, Formosa, Japan.

DISTRIBUTION IN JAPAN. Kyushu, Western Honshu. We have seen specimens from Nagasaki.

The larvae breed in artificial containers, concrete cisterns and rock pools. They are often found in polluted water. The adults are not known to attack man in nature but have been induced to feed in the laboratory. Hu (1940) working in China obtained infective larvae of W. bancrofti in a small number of cases.

CULEX (CULEX) BITAENIORHYNCHUS Giles.

Culex bitaeniorhynchus Giles, 1901. Jour. Bomb.Nat. Hist. Soc. 13: 607 (type loc.: Tranvancore, S. India).
Culex bitaeniorhynchus karatsuensis Mochizuki, 1913. Mag. Fukuoka Med. Col. 7(1): 28 (type loc.: Karatsu, Kyushu).

DISTRIBUTION. Throughout the Oriental Region.

DISTRIBUTION IN JAPAN. Common in Kyushu, and comparatively rare in Shikoku and southwestern and central Honshu. We have seen specimens from Nagasaki.

This is a rather large yellowish brown species attaining a body length of about 6 mm. The larvae occur in relatively clean water of rice paddies, stream pools, and ditches, especially where filamentous green algae are present. Adults generally attack man at night but sometimes also during the day. S. Yamada (1927) recorded only a partial development of W. bancrofti larvae in this species. It has been reported as a vector of Japanese "B" encephalitis in the Soviet Far East by Chagin and Kondrat'yev (1943).

Numerous subspecies or varieties have been described. Among these is karatsuensis Mochizuki. According to the original description it does not differ significantly from the typical form and we are following Edwards (1932) in considering it a straight synonym. The speckled wings furnish a good recognition character.

CULEX (CULEX) SINENSIS Theobald.

Culex gelidus var. sinensis Theobald, 1903. Mon. Cul. 3: 180 (type loc.: Shaohyling, China).
Culex tripunctatus Mochizuki, 1913. Jour. Fukuoka Med. Coll. 7(1): 23 (type loc.: Fukuoka, Japan).

DISTRIBUTION. Throughout the Oriental Region.

DISTRIBUTION IN JAPAN. Common in Kyushu, also found in Honshu and Karafuto.

This is a medium-sized dark species with contrasting dark scales on the scutum. The larvae breed in rice fields, weedy ponds, or pools in stream beds. The adults are frequently found inside dwellings and vigorously attack man at night. It is reported to be abundant during late summer in Kyushu, where filariasis is common. However, S. Yamada (1927) found mature filarial larvae in only 6 (15.4 per cent) of 39 specimens experimentally infected, and considered this species to have a low degree of suitability as an intermediate host of W. bancrofti.

CULEX (CULEX) WHITMOREI (Giles).

Taeniorhynchus whitmorei Giles, 1904. Jour. Trop. Med. 7: 367 (type loc.: Philippine Islands).
Leucomyia plegipennis Theobald, 1907. Mon. Cul. 4: 375 (type loc.: Kobe, Japan).

DISTRIBUTION. Throughout the Oriental Region.

DISTRIBUTION IN JAPAN. Kyushu, Honshu.

This is a small dark brown species somewhat similar to C. sinensis but with more contrasting white markings on the scutum. The larvae breed in clear fresh water pools with sandy bottoms containing considerable decayed vegetable matter. The adults are vigorous biters, especially in the early evening. S. Yamada (1927) reported that a great many filarial larvae mature in this species and considered it as a suitable intermediate host for W. bancrofti.

CULEX (CULEX) MIMETICUS Noé.

Culex mimeticus Noe, 1899. Bull. Soc. Ent. Ital. 31: 240 (type loc.: Grassana in Basilicata).

DISTRIBUTION. India, Burma, Thailand, China, Indochina, Malaya, Formosa, Japan.

DISTRIBUTION IN JAPAN. Honshu (Yokohama), Kyushu. We have seen specimens from Nagasaki and Yumoto (Kanagawa).

This is a spotted-winged species superficially resembling an Anopheles. Larvae are found in rice paddies and other pools, and in slowly flowing streams. They are generally associated with green algae. The adults have occasionally been observed in dwellings but apparently do not bite man.

CULEX (CULEX) ORIENTALIS Edwards.

Culex orientalis Edwards, 1921. Bull. Ent. Res. 12: 338 (type loc.: Tokyo, Japan).

DISTRIBUTION. China, Japan, Korea, and Siberia.

DISTRIBUTION IN JAPAN. Northern Honshu and Hokkaido. We have seen specimens from Tokyo.

This is a medium-sized species with spotted wings. The larvae are not known from Japan but they have been collected in China (Hangchow) from lotus ponds and spring ponds and from lakes with much surface vegetation (Mukden). The species is not known to attack man.

The adults are similar to those of mimeticus but have the first pale costal wing spot much more extensive.

CULEX (CULEX) TRITAENIORHYNCHUS Giles.

Culex tritaeniorhynchus Giles, 1901. Jour. Bomb. Nat. Hist. Soc. 13: 606 (type loc.: Travancore, S. India).

DISTRIBUTION. Throughout the Oriental Region, West Africa and Egypt.

DISTRIBUTION IN JAPAN. Kyushu, Shikoku. Honshu. We have seen specimens from Nagasaki.

This is a small dark reddish brown species with a banded proboscis. The larvae occur in ponds, ditches, rice paddies, wells, artificial containers, and numerous other habitats. The females bite at night in and outside of dwellings. In addition to humans they feed readily on horses in nature.

S. Yamada (1927) found that 8.2 per cent of filarial larvae completed their development in tritaeniorhynchus and considered it of low suitability as an intermediate host of W. bancrofti. Both experimental and natural infection with Japanese "B" encephalitis were reported by Mitamura et al. (1939). It has also been given as a vector in the Soviet Far East by Russian workers (Chagin and Kondrat'yev, 1943).

CULEX (CULEX) VISHNUI Theobald.

Culex vishnui Theobald, 1901. Mon. Cul. 1: 355 (type loc.: Madras, India).
Culex annulus of Yamada, 1927. Sci. Rept. Gov't. Inst. Inf. Dis. 6: 574.
Culex biroi of Mochizuki, 1913. Jour. Fukuoka Med. Coll. 7: 1 - 65.

DISTRIBUTION. Throughout Oriental Region and New Guinea.

DISTRIBUTION IN JAPAN. Common in Kyushu, Shikoku, and southwestern Honshu and rare in central Honshu. We have seen specimens from Nagasaki.

This is a small brown species, the larvae of which breed in ponds, rice fields, and other ground water situations. Females bite during the night. According to Yamada (1927), larvae of W. bancrofti undergo only partial development in this species.

CULEX (CULEX) QUINQUEFASCIATUS Say.

Culex quinquefasciatus Say, 1823. Jour. Acad. Nat. Sci. Phil. 3: 10 (type loc.: North America).
Culex (Culex) fatigans Wiedemann, 1828. Aussereurop. Zweifl. Ins. 1: 10 (type loc.: East Indies).
Culex fouchowensis Theobald, 1901. Mon. Cul. 2: 137 (type loc.: Fouchow, China).

DISTRIBUTION. Widely distributed in the tropical and subtropical regions.

DISTRIBUTION IN JAPAN. Kyushu and also Ryukyu. We have seen specimens from Nagasaki.

The larvae breed in a wide variety of small water collections, especially those containing organic matter. The species is domestic and the adults show a strong preference for man. S. Yamada (1932) reported this species as a very suitable intermediate host of W. bancrofti.

The species is very closely related to C. pipiens pallens. See discussion under that species.

CULEX (CULEX) PIPIENS PALLENS Coquillett.

Culex pallens Coquillett, 1898. Proc. USNM 21: 303 (type loc.: Japan).
Culex pipiens of authors.
Culex osakensis Theobald, 1907. Mon. Cul. 4: 439 (type loc.: Osaka, Japan).

DISTRIBUTION. China, Korea, Japan.

DISTRIBUTION IN JAPAN. Very common from Kyushu to Hokkaido. We have seen specimens from Tokyo, Sendai, Nagoya, Gifu, Okayama, Sapporo, and Matsushima (Nagasaki).

The larvae breed in almost any collection of water, especially where considerable organic matter is present. It is a strongly anthropophilic domestic species, generally attacking at night. S. Yamada (1927) considered it to be one of the most suitable hosts for W. bancrofti, and reported that 86.9 per cent of the filarial larvae matured in this species. Both experimental and natural infection with Japanese "B" encephalitis, as well as hereditary transmission of the virus, have been reported for this species by Mitamura et al. (1939). Russian workers reported it as a vector of Japanese "B" encephalitis in the Soviet Far East (Chagin and Kondrat'yev, 1943).

This mosquito is very closely related to C. quinquefasciatus and

some Japanese records of pallens may refer to the other species. The larvae of quinquefasciatus have a shorter siphon and the adult differs slightly in male genitalia. C. pipiens pallens is supposed to be common in Kyushu. Yet, all specimens we have examined from a general collection from Nagasaki were quinquefasciatus. In all probability the ranges of the two species overlap in Kyushu.

CULEX (CULEX) VAGANS Wiedemann.

Culex vagans Wiedemann, 1828. Aussereurop. Zweifl. Ins. 1: 545 (type loc.: Foochow, China).
Culex tipuliformis Theobald, 1901. Mon. Cul. 2: 325 (type loc.: Bakloh, N. W. Provinces, India).
Culex virgatipes Edwards, 1914. Bull. Ent. Res. 5: 126 (type loc.: Hongkong).

DISTRIBUTION. China, northern India, Japan and Saghalien.

DISTRIBUTION IN JAPAN. Kyushu, Honshu, and Hokkaido. We have seen specimens from Nagasaki.

The larvae breed in lakes, ponds, and pools with filamentous algae. Adults attack man at night. S. Yamada (1927) reported this species as a very suitable host of W. bancrofti.

Larvae are indistinguishable from those of pipiens, according to Barraud (1934). The adults are readily recognized by the striped legs.

IV. MOSQUITO-BORNE DISEASES IN JAPAN

FILARIASIS

Filariasis is widespread in tropical and subtropical regions. In Japan the disease has been reported from various localities but more commonly on Kyushu and its adjacent islands. According to Yokogawa and Morishita (1939), the prefectures of Kagoshima and Okinawa are the most heavily infested areas in Japan. As high as 26 per cent of the population in Satsuma and Izumi Counties were found to be harboring the parasite; 26.3 per cent infestation was found on Koshiki, 24.8 per cent on Oshima, 21.2 per cent on Tanega-shima[6/], 32.8 per cent on Kakeroma-jima, 39.8 on Tokuno-shima, 30.6 per cent on Okinoerabu-shima, 30.7 per cent on Kikai-shima, and 28.0 per cent in Amakusa. Imazona (1938) reported that human filariasis is very prevalent on the peninsulas of Osumi and Satsuma and along the coastal region of Hanare-jima, where from 30 to 40 per cent of the population are affected. The same author reported that 19.3 per cent of the soldiers from Kagoshima Prefecture were found to be carriers of the parasite. Miyakawa (1945) stated that in Kagoshima, Matsushita et al. discovered microfilariae in 44.4 per cent of chyluria patients and in 36 per cent of apparently healthy persons by blood examinations. In the Okinawa Prefecture, which is composed of the southern islands of the Ryukyu Archipelago, 21.88 to 35.55 per cent infection was reported (Yokogawa and Yumoto, 1939). Ohama (1939, 1941) found an average of 24.04 per cent of the school children in Yaeyama district to harbour the worms. In 1939 Saigo examined 7,766 persons on Okinawa and found 1,040 (13.39 per cent) with lymphangitis, 83 (1.07 per cent) with chyluria and 151 (1.94 per cent) with elephantiasis (Miyakawa, 1945). Recent investigations by the Military Government confirm the high incidence of the disease on Okinawa. On Kyushu the disease is also prevalent in the Prefecture of Kumamoto, Nagasaki, and Miyazaki while the infestation in Oita, Saga, and Fukuoka Prefectures is comparatively light.

On Shikoku the disease is most common in Ehime and Kochi Prefectures. On Honshu it is prevalent in Niigata Prefecture, especially in the mountainous region where from 5 to 14 per cent of the apparently healthy inhabitants were found to be parasitized by microfilariae (Takenouchi, 1936). A large number of cases have been reported from Fuji County of Shizuoka Prefecture, the coastal area of Wakayama Prefecture, Oki Island of Shimane Prefecture, and Hachijo Island of Tokyo

6/ The suffixes "shima" and "jima" are equivalent to the English word "island".

Prefecture. Only occasional cases have been reported from Mie, Gifu, Fukui, Ishikawa, Yamanashi, Chiba, Miyagi, Yamagata, Iwate, Aomori, and Hokkaido (Yokogawa and Morishita, 1933; Miyakawa, 1945). The Japanese Statistical Bureau reported 132 deaths from filariasis (chyluria) in the main islands of Japan and the Ryukyus in 1937, and 129 in 1938. About 85 per cent of the deaths were reported from Kyushu and the Ryukyus, 3 per cent from Shikoku, 12 per cent from Honshu and none from Hokkaido.

Wuchereria bancrofti is the only species of filaria dangerous to man reported in Japan. Nakagawa (1936), in searching for the existence of W. malayi in Japan, found 78 out of 915 persons to be microfilaria carriers but all of them were carrying W. bancrofti. All literature on filariasis in Okinawa refers to W. bancrofti. Yokogawa and Morishita (1933), and Miyakawa (1945) made no mention of the presence of W. malayi in Japan.

The transmission of filariasis by mosquitoes has been repeatedly demonstrated since the discovery of Manson that Culex quinquefasciatus (C. fatigans) was a vector of W. bancrofti at Amoy, China. In Japan the subject has been studied by several investigators. S. Yamada (1927) summarized the results of the early workers and made an extensive study on 24 species of mosquitoes regarding their suitability as intermediate hosts of W. bancrofti. He concluded that 7 species in which the filarial larvae completed their development were suitable hosts of the parasite, viz., Aedes togoi, Culex pipiens pallens, C. vagans (C. tipuliformis), C. whitmorei, C. sinensis, C. tritaeniorhynchus and Anopheles sinensis. In the first four species, a great number of filarial larvae completed their development, indicating a higher degree of suitability as intermediate hosts while in the last three species only a comparatively small number of the larvae reached the infective stage, indicating a low suitability as vectors of the disease. The filarial larvae only partially developed in Armigeres subalbatus, Culex bitaeniorhynchus, Aedes chemulpoensis (not Japanese), Aedes galloisi, Aedes albolateralis, Aedes albopictus, Aedes "esoensis flavus", and Culex vishnui. In the following species the larvae did not develop at all, viz., Anopheles sineroides, Aedes dorsalis, Aedes japonicus, Aedes esoensis, Aedes imprimens, Aedes sticticus, Aedes vexans nipponii, Aedes koreicus and Tripteroides bambusa. Abe (1937), Yokogawa (1938), and Kobayashi (1941), considered Culex quinquefasciatus as an important vector of W. bancrofti in the Ryukyus and Formosa.

JAPANESE "B" ENCEPHALITIS

Japanese "B" encephalitis has frequently occurred in epidemic proportions since 1871 in certain regions of Japan. However, it attracted little attention until the great epidemic in 1924. Much experimental work has been done as to the etiology and mode of transmission of the disease by many Japanese workers since this epidemic. It is generally agreed that the causative virus is similar to, but not identical with, that of the "St. Louis" type. Kawamura et al. (1936, 1937) showed that the two viruses (Japanese "B" and "St. Louis") were immunologically distinct on the basis of both the sera of human patients and the sera of experimentally infected animals. The same conclusion was reached by many other Japanese workers (Taniguchi et

al. 1936; Kasahara et al. 1937). In mice infected with the two strains there were no pathological differences, but this was not true with monkeys.

Although sporadic cases of Japanese "B" encephalitis have been reported from other parts of the world (China, Formosa, Manchuria, Siberia), epidemics have been confined to Japan and the Ryukyus. In the main islands the disease has a fairly wide distribution ranging from Kyushu to the northern tip of Honshu. The heaviest concentration of the infection has been found in Fukuoka, Toyama, and in the Prefectures bordering the Inland Sea (Kagawa, Okayama, and Hyogo). There have been only a few cases reported from Hokkaido. In 1924, a total of 6,125 cases were reported with a case fatality of 62.0 per cent (Anon., 1936). The disease has occurred annually since 1924 with a total of 21,355 cases from 1924 to 1937 and a case fatality of 56.9 per cent. The highest incidence occurred in 1924, with 6,125 cases and 3,797 deaths and in 1935 with 5,370 cases and 2,264 deaths (Rappley et al. 1939). During the 1935 epidemic 1,500 cases were reported in Tokyo alone (Kasahasa et al. 1936). The Japan Culture Promotion Association (Anon., 1936) reported a total of 12,341 cases from 1924 to 1933 with 7,991 deaths, representing an average case fatality rate of 64.8 per cent. These cases were distributed according to prefectures as follows:

Prefectures	Total	Incidence per 100,000 population	Prefectures	Total	Incidence per 100,000 population
Hokkaido	8	0.3	Mie	7	0.6
Aomori	103	12.7	Shiga	17	2.6
Iwate	0	.0	Kyoto	155	11.0
Miyagi	47	4.5	Osaka	478	15.6
Akita	93	9.9	Hyogo	2126	86.6
Yamagata	23	2.2	Nara	18	3.1
Fukushima	13	0.9	Wakayama	93	11.8
Ibaraki	14	1.0	Tottori	318	67.3
Tochigi	13	1.2	Shimane	171	23.7
Gumma	18	1.6	Okayama	1842	148.7
Saitama	7	0.5	Hiroshima	640	39.6
Chiba	19	1.4	Yamaguchi	201	18.3
Tokyo	268	6.0	Tokushima	379	54.9
Kanagawa	24	1.8	Kagawa	2871	410.0
Niigata	92	5.0	Ehime	568	51.8
Toyama	791	105.6	Kochi	70	10.2
Ishikawa	39	5.2	Fukuoka	329	14.3
Fukui	27	4.5	Saga	16	2.3
Yamanashi	10	1.7	Nagasaki	35	3.0
Nagano	222	13.6	Kumamoto	2	0.2
Gifu	22	1.9	Oita	3	0.3
Shizuoka	5	0.3	Miyazaki	15	2.2
Aichi	44	1.9	Kagoshima	17	1.2
			Okinawa	68	12.2

A recent intelligence report shows that during the summer of 1945 (from July to September) 91 clinical cases of "B" encephalitis were reported on the island of Okinawa among the natives and 36 cases on the nearby islands of Heanza and Hamahika. Thirty-eight cases were reported among the American troops during the same period.

Cases of the disease have been reported throughout the year but the outbreaks are usually limited to late summer and early autumn. The Japan Culture Promotion Association (Anon., 1936) showed that the highest percentage of cases always occurred in August or September of each year for the period of 1924-1933. Of the total number of cases during this period (12,341), 59.8 per cent occurred in August and 31.1 per cent in September. Iimura showed that of 5,370 cases in 1935, 2,872 occurred in August and 2,248 in September (Rappley et al. 1939). Kusaka and Nakashima (1937) reported that all the cases admitted to the Okayama Medical College occurred in August in 1933, in late July to the middle of August in 1935 and in late September in 1936.

Climatic factors seem to be correlated with the outbreaks of the disease. Epidemics usually have occurred in hot summers with high temperatures and have ended completely with the arrival of cool fall weather. More cases have occurred in dry weather than in wet. The amount of rainfall in the month preceding the epidemic is particularly indicative (Anon., 1936).

The disease attacks persons of all ages, but the morbidity seems lower between 20 and 50 than in the younger or the older groups. Mortality is progressively higher as the age increases. There is no apparent correlation between the morbidity and the density of population (Anon., 1936).

Mode of Transmission.--There have been two schools of thought among Japanese workers regarding the spread of Japanese "B" encephalitis, (1) by droplet infection and (2) by insect vectors. Takagi (1925) considered that the causative virus entered the body through the nasal cavity, and this view was shared by Kawamura et al. (1936). The virus is supposed to infect the olfactory nerve and then spread to the brain and central nervous system. On the other hand many other Japanese investigators favor the mosquito transmission theory. In 1937, Mitamura et al. (1937) reported their experimental evidence in support of this theory. Mosquitoes (Culex pipiens pallens) were infected by feeding them on infected brain emulsion. They were then allowed to bite mice and apes. Encephalitis was produced in both animals. They further reported that they found naturally infected C. pipiens pallens which transmitted encephalitis to the experimental animals. Mitamura et al. (1939) made an investigation in Okayama to determine the numbers of mosquitoes during different times of the year. It was found that there was a peak in early spring when the hibernating adults appeared and another in summer (maximum at the end of July) when the new adults emerged. The principal species were Culex pipiens pallens and C. tritaeniorhynchus, followed by Anopheles sinensis. Aedes togoi and Aedes albopictus were rare. Three weeks after the "mosquito peak" an epidemic of encephalitis broke out. Experimental infection was made with Culex pipiens pallens, C. tritaeniorhynchus and Aedes togoi with positive results in all of the species. It was found possible to experimentally infect 8 out of 20 specimens of C. pipiens pallens. The virus was not only found in the eggs and larvae of artificially infected adults of

this species but also in the adults which developed from these larvae, thus showing that the virus can be transmitted from generation to generation. Natural infection was found in C. pipiens pallens and C. tritaeniorhynchus.

Chagin and Kondrat'yev (1943) reported that Ae. japonicus, Ae. togoi, and C. tritaeniorhynchus are important vectors of Japanese "B" encephalitis in the Soviet Far East. C. bitaeniorhynchus plays a minor part in transmitting the disease in this region. Ae. esoensis was also suspected to transmit the virus.

MALARIA

Due to the relatively cold climate and the small number of anopheline mosquitoes, malaria was not a serious health problem in Japan before the last war. The disease was lightly endemic in a few areas, viz., Fukui, Ishikawa, Shiga, Fukuoka, Kumamoto, Saga, Shizuoka, Aichi, Gifu, Mie, Kochi, and Kagoshima. Only isolated cases were reported from other prefectures. The only endemic type of the disease in Japan is vivax-malaria. Imported cases of malariae and falciparum have also been reported. The disease (vivax) is common in Okinawa Prefecture, and the southern islands of the chain have considerable falciparum-malaria.

Malaria is not a reportable disease in Japan and no reliable morbidity statistics of the disease are available. According to the official reports there were 74 deaths from malaria in the Japanese main islands and the Ryukyus in 1933, 53 in 1934, 51 in 1935, 76 in 1936, and 65 in 1937. The fatal cases were from all parts of the country including Hokkaido, but more than half were reported from Okinawa Prefecture. In 1938 the number of deaths increased to 207, about three times as high as the preceding years, and it may be significant that the Sino-Japanese War began in 1937. According to Awaya (1942) over 1,000 malarial cases were reported by the Welfare Department from the main islands of Japan and the Ryukyus in 1938 and the majority of the cases were from Fukui, Shiga, Okinawa, Ishikawa, Aichi, and Toyama. According to the same author, Ibuki reported that 15 per cent of 350,000 Japanese soldiers stationed in Central China carried malaria parasites, and 16 per cent of the soldiers of a returned division harboured the disease.

Malarial cases occur during most of the year in southern Japan, except in the cold winter months. It is most prevalent in late summer. Suzuki (1939) showed that of 122 malarial cases among the employees of two factories in Shiga, 95 (77.8 per cent) occurred in the months of June to September and 61 (50 per cent) were in the months of July and August.

Anopheles sinensis is the most common species of anopheline mosquitoes in Japan. Although there is considerable difference in the indicated role in malaria transmission in other areas of its range, it is regarded as the only Japanese vector of the disease. A. lindesaii japonicus has been suggested to be a weak vector but it plays no known role in malaria transmission elsewhere. Other species of Anopheles recorded from Japan are koreicus, edwardsi, and sineroides none of which is known to carry malaria.

DENGUE

Dengue fever is prevalent in warm climates throughout the world. It was not reported from Japan prior to 1913 and it is considered that the disease was imported to Japan from Formosa and the Ryukyus where it has been epidemic from time to time (Kitano, 1931). In Okinawa there were 6 epidemics prior to 1931, in 1892, 1902, 1912, 1916, 1924, and 1931. In the 1931 epidemic 35,100 cases were reported from June to October in Okinawa Prefecture (Miyao, 1931). The epidemic extended northward into Kagoshima on Kyushu with a small number of cases. In 1933 many cases were reported among the factory workers in Wakayama. In 1942 the disease spread rapidly over Kyushu. Cases were first reported from Nagasaki in the first part of September and the disease spread to Kobe and Osaka, infecting over 4,000 people by the middle of the month. It was estimated that the actual number of cases was far greater (Miyakawa, 1945). Earlier records of dengue fever in Japan are few. A total of 260 cases were reported from the Japanese Army from 1913 to 1927; 4 in 1913, 115 in 1916, 60 in 1922, 67 in 1925 and 14 in 1927. Cases were also reported from Chichi-jima of the Bonin Islands (Kitano, 1931).

Miyao (1930) considered both Aedes aegypti and Ae. albopictus as the main vectors of dengue in Okinawa. Hosoya presented data indicating that Ae. aegypti is a better vector than albopictus (Miyakawa, 1945). Aedes aegypti (Stegomyia fasciata) is one of the best known mosquitoes and is worldwide in its distribution between 40°N. and 40°S. The species is common in Formosa and parts of the Ryukyus, and is found also in Chichi-jima among the Bonin Islands, but has not been reported from the Japanese main islands. According to Hosoya, in Okinawa 66.6 per cent of the mosquitoes collected during the 1931 dengue epidemic and 47.1 per cent collected at the end of the epidemic belong to this species (Miyakawa, 1945). Larvae of aegypti breed in all types of artificial accumulations of water near habitations. The adult females are exclusively domestic and strongly anthropophilic. Aedes albopictus is also a common mosquito and is widely distributed. In Japan it is found on Kyushu, Shikoku and Honshu. This species has been shown to be a vector of dengue fever in China (Canton) by Buddle (1928) and in the Philippines by Simmons et al. (1930, 1931). In Okinawa, Miyao (1930) considered this species as one of the main vectors of dengue but Hosoya stated that in 1931 only 4.4 per cent of the mosquitoes collected at the end of the Okinawa epidemic belonged to this species and none was collected during the epidemic. However, in view of the fact that dengue fever has been prevalent on Kyushu in recent years and that aegypti is apparently absent in this area, the role of Ae. albopictus in transmitting the disease seems obvious. The larvae of this species breed frequently in habitats similar to those of aegypti. The adult females are also strongly anthropophilic and bite during the day.

YELLOW FEVER

Yellow fever was found to be epidemic in Southern Europe and in North America during the eighteenth and nineteenth centuries. At present it is known to be endemic in South America and Central Africa. The Oriental Region, however, for unknown reasons has remained free of the disease. A search among the available Japanese medical literature has not revealed any record of the disease as being present in that country, with the only exception being a record of an official source (Anon., 1927-1937) which showed three reported cases--a female case from Saga Prefecture in 1927, a male case from Oita Prefecture in 1927, and a female case from Saga Prefecture in 1937. Owing to the fact that these three cases occurred years apart and no other cases were recorded, it appears that, although these three cases were assumedly diagnosed correctly they probably were not indigenous.

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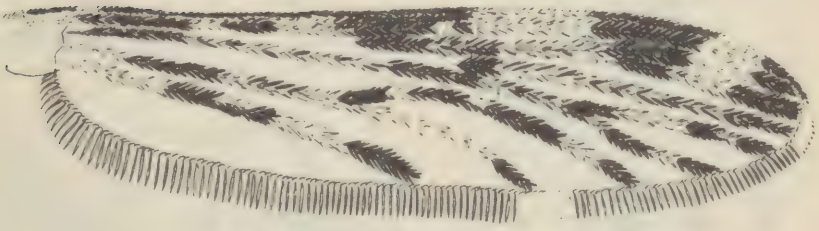
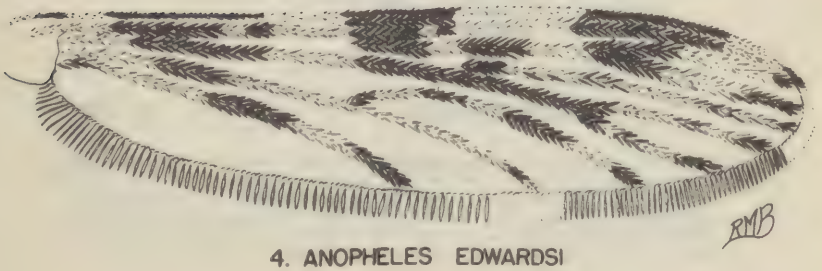
1. ANOPHELES SINENSIS



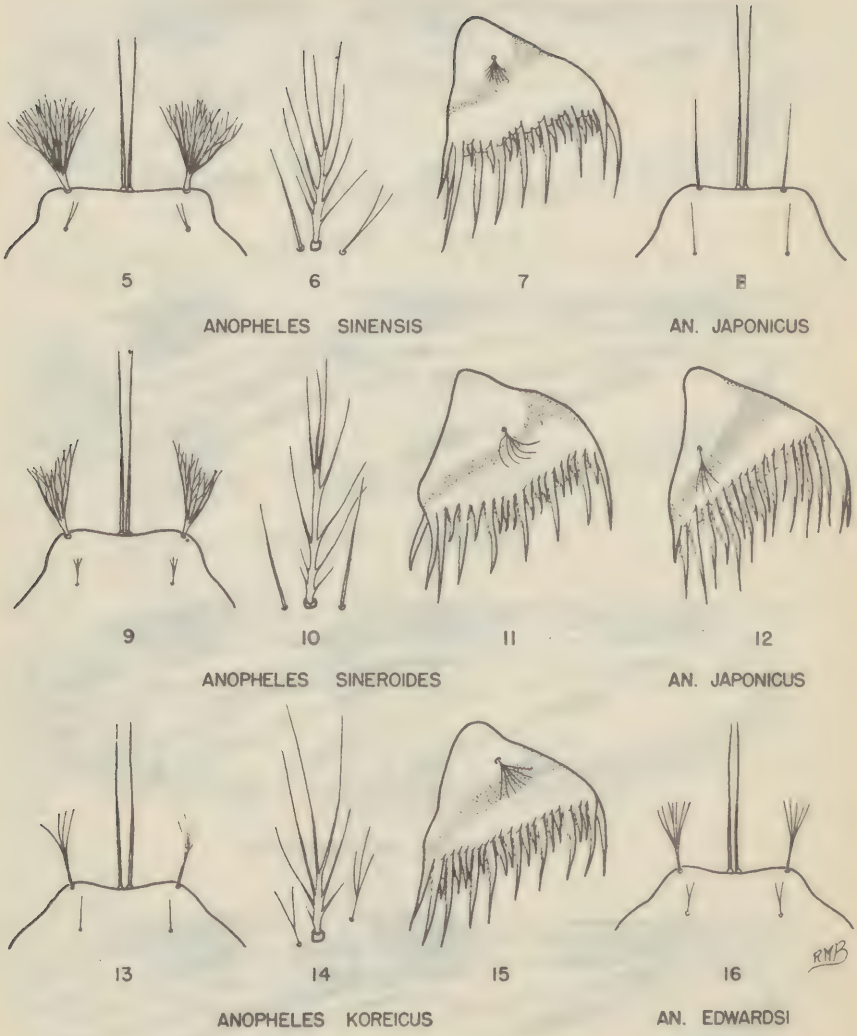
2. ANOPHELES SINEROIDES

3. ANOPHELES KOREICUS

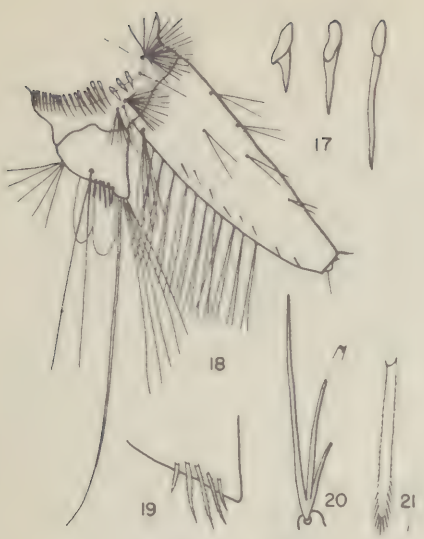


4. ANOPHELES EDWARDSI

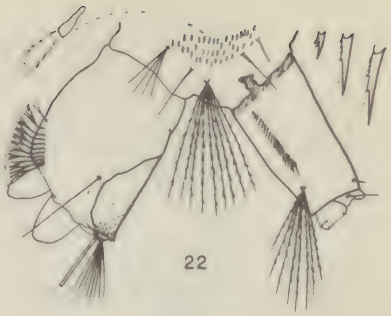
Figures 1-4.--Wing pattern of four species of Japanese Anopheles: Figure 1, from an Okinawan specimen; figure 2, from Uenohara, Honshu; figure 3, from Nagasaki, Kyushu; figure 4, from Yumoto, Honshu.



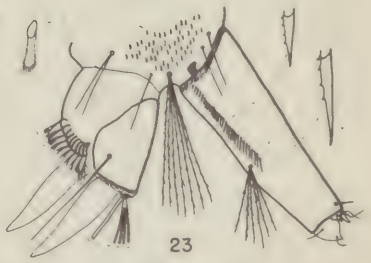
Figures 5-16.--Details of Japanese Anopheles larvae: Figures 5, 8, 9, 13, and 16, front head; figures 6, 10, and 14, left prothoracic submedian hairs; figures 7, 11, 12, and 15, pecten. An. sinensis from a Nagasaki, Kyushu specimen; japonicus redrawn from Feng (1931); sineroides from a Seoul, Korea specimen except for pectin which was redrawn from M. Yamada (1936); koreicus from Nagasaki, Kyushu; edwardsi from a Uenohara, Honshu specimen.



TRIPTEROIDES BAMBUSA



AEDES TOGOI



AEDES KOREICUS

AEDES JAPONICUS

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Figures 17-27.--Details of Japanese Culicines: Figure 25, adult; other figures, larvae. Figure 17, three sizes of comb teeth; figure 18, segments VIII and IX; figure 19, posterior margin of anal ring enlarged; figure 20, left metathoracic spine; figure 21, pectin tooth; figures 22 and 23, segments VIII and IX; figure 24, head, dorsal; figure 25, scutal pattern; figures 26 and 27, variations in siphon. T. bambusa and Ae. togoi from an Okinawan specimen; Ae. koreicus from a Seoul, Korea specimen.


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